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FOREST-WIDE EXTENSIVE INVENTORY FOR THE TREE RESOURCES OF THE BIGHORN NATIONAL FOREST

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for the

TREE RESOURCES

of the

BIGHORN NATIONAL FOREST

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FOREST-WIDE EXTENSIVE INVENTORY FOR THE TREE RESOURCES OF THE

BIGHORN NATIONAL FOREST

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I. INTRODUCTION

A. Situation

A new inventory is needed on the Bighorn National Forest within the next few years, as scheduled in the R-2 program. Field work for the last Forest inventory was done in 1971, with the resultant Timber Management Plan approved in 1975. At that same time, silvicultural systems changed dramatically, from all clearcutting to primarily shelterwood. This change increased the acreage treated by a factor of three or four times, to maintain a volume removal equal to clearcutting. As a result, a great many acres have been modified since the last inventory and data has not been analyzed on shelterwood results.

Since the Timber Management Plan was approved, two amendments have been required due to changes in Land Classification with RARE I and RARE II studies. Other resource constraints may now require additional changes.

The Bighorn Forest Plan is being developed, but without a new inventory. The 1971 inventory was adjusted by estimating changes in growing stock volume and acres. The Forest Plan should provide new changes in Land Class, approved through the NEPA process, which will guide the inventory and treatment simulations for a more precise Potential Yield.

There is perhaps an even more compelling reason for re-inventory. In 1973 the Bighorn began a piecemeal program of Stage II inventories. This program is now developed to the point where it needs to be consolidated into one project. The existing stand delineations need to be mapped Forest-wide and their acreages balanced with official Forest area calculations. Unworked sections of the Forest need to be delineated to the stand level

and fitted to the existing stands. At that point, the Forest would have at least photo-interpretive data (survey type 9/3) on all tree resources, along with an accurate area calculation.

B. Description

The 1,107,435 net acres of the Bighorn National Forest have a distribution of approximately 62 percent forest, 38 percent water and non-forest land. In the 1975 Plan about 48 percent of the total Forest was determined to be Suitable and Available. Regulated species included lodgepole pine, Engelmann spruce, subalpine fir, and some ponderosa pine. Douglas-fir, limber pine, aspen, and most ponderosa pine was Unregulated. It is now felt that capable and available Douglas-fir and ponderosa pine should be Regulated.

The majority of the commercial forest is on a plateau between 7,000 and 9,000 feet, quite evenly divided between lodgepole and spruce/fir sawtimber volumes. Much of the Forest is old growth, thick stands of saplings, or regenerating clearcuts. For good size class distribution, the Forest is lacking small sawlogs and poles growing into the sawtimber sizes.

The Bighorn National Forest boundaries are generally at 6,000 feet on the east face and 8,000 feet on the west face of a single ridge of mountains, surrounded by plains. Private land coming part way up the initial incline makes access from east and west difficult, limited to two major highways and five lower standard roads. The Crow Indian Reservation at the Montana state line block the north end. Two gravel roads access the south end.

The boundary on most of the Forest lies along a sedimentary rock layer, quickly grading into granitic plateau, with ponderosa pine and Douglas-fir grading quickly into lodgepole pine and spruce/fir forests. The north end has the sedimentary layers carried on into the plateau, where the ponderosa and Douglas-fir give way to predominantly spruce/fir in the cooler uplands. Lodgepole pine is less evident on the north end.

The Bighorn Mountains are also characterized by large, permanent, dry grasslands bordered by dense thickets of trees. The meadows make wildlife visible to the recreating public and also make the trees important as hiding cover. The Forest is situated between the population centers of the Lake States and Yellowstone National Park, making esthetics and recreation important management concerns.

Past sales have concentrated logging along the areas served by the highways, the same acres tie-hacked from 1900 to 1935. This covers about half of the forest lands. The other half is rough land, with limited access.

Most of the present harvest in sawlogs is done by Wyoming Sawmills, Inc., of Sheridan, Wyoming. Pole timber is primarily worked by Cowboy Treating of Manderson, Wyoming, and Sheridan Forest Products of Sheridan, Wyoming. Equipment is strictly a tractor-skidding operation. No cable equipment has been used, nor is any planned by present purchasers. Sawlogs down to 7" DBH are in current utilization standards. Further reductions to 6" are possible, but not presently planned. Pole timber operators generally take material down to about 4" DBH. Haul costs are a chronic problem, with

haul distances of 60 miles as a minimum. Competition for sales is not a significant factor, with only one sawlog operation and a few pole cutters. Sheridan has been designated a Dependent Community.

Firewood cutters are a growing influence on the Forest, but have not yet become major users, due to the sparse local population.

C. Past Inventories and Plans

Timber management began with a "Marking Policy Statement" on February 1, 1926. No extensive inventory was made. Volume was estimated from rough type maps drawn up for easily accessed areas. A continuing supply was assumed because "selection cutting systems" were applied to all species. Clearcuts were allowed, but only in areas where fire, wind, insects, or stagnation would render the timber unusable if not cut. The need for thinning was recognized, but little hope for accomplishment expressed.

In 1940 the new statement essentially continued the old, except for the sophistication of using crown classifications in choosing the leave trees.

In the 1950's, clearcutting moved from the purely decadent stands into a system for removing mature-overmature stands before they advanced to decadence. Allowable Cut was based on a 40 year cycle to remove old growth. Cutting then began to show some significant silvicultural effects, calling for long-term planning.

In 1958, a Forest-wide field inventory and type mapping was initiated for the Bighorn. The inventory used 189 plots of concentric circles. The

maximum sized circle was 1/5 acres, for sawtimber. Smaller circles were for poles, seedlings/saplings, etc. Type maps were drawn from 1956 aerial photos, using a 2" = 1 mile scale township base. The inventory data was expanded for the typed acreages to calculate the Total Growing Stock Volume. Again, a 40 year cycle was used to determine the Allowable Cut.

The re-inventory in 1971 remeasured 60 of the original plots and 300 new ten-point clusters, stratified by the major species, size-class, age, and existing regeneration over the 1958-59 type maps were again used, updated by 1970 aerial photos and input into the R-2 MAP computer system. This time growth simulations were used in R-2 GROW and Timber RAM computer models to calculate Potential Yield rather than Allowable Cut.

The basic inventory utilized a photo point sampling system. Some 9,200 photo points were established on the Bighorn and acres were determined by proportioning the total acres on the Forest. As an example, if there were 490 lodgepole sawtimber plots, the acres would be determined by dividing 490 by 9,200 and taking that times the net Forest acreage.

$$\frac{490}{9,200} = 58,966 \text{ acres}$$

In order to further stratify the acres derived by this sampling, Forested acres were run on computer by the R-2 MAP system and reconciled back to the sample acres.

These inventories provided data for the Forest, but not site-specific in-formation on where a given stand condition could be found.

In 1973 some site-specific (Stage II) inventories were started. These began as pre-sale data collection, inventorying only sawtimber stands. In 1975 the technique was changed to delineating compartments of 600 to 1200 acres and divided the entire compartment into Units. These Units met the criterea for stands and also divided non-forested areas into relatively homogeneous parcels. Data was collected on all units in each compartment entered. Usually the annual project work included two or three scattered areas of 3-6 compartments each.

The pattern has now filled in some large contiguous areas over several years of such projects, without properly accounting for their area in relation to official acreage figures.

Starting in 1975, the data collection was termed Resource Inventory. In addition to tree data, the inventory collected soil profiles, understory vegetation, wildlife habitats, stream conditions, and forage production. College students in soil, range, watershed, and wildlife were teamed with forestry students to take the inventory.

The wildlife and range data has since been dropped. Populations are too mobile and forage conditons too transient to allow any meaningful data collection. The stream reach inventories have been completed for the Forest by the Hydrologist. The understory vegetation is described by plant association, which is still collected. Soils scientists have completed their Order 3 S.R.I., but soils data is still incorporated into Stage II Inventory by stand typing on landform and soils breaks. It is felt that a

change in soils parent material or landform (slope, slope position, soil deposition or scouring, etc., per Albert Hahn's classifications) often represents a change in site that should be reflected in management. These changes normally form divisions in the range of 150-200 acres, changes of 10 points in the Site Index at base age 100, and/or modifications in road construction and logging costs. Further stand boundary breakdowns are by the standard Silvicultural Exam Handbook stand classification of size, species, etc.

D. Goals and Objectives

In addition to the objectives stated in FSM 2410, this inventory will be aimed at collecting data so that the tree resource can be integrated with other uses besides timber. The stand map will be the primary tool for integration of resource data. Because of the constraints imposed by these other resources, it is critical that this inventory be designed to give site-specific data. Scheduling of big game cover changes or water production recovery may influence the actual yield of the Bighorn as much as tree measurement, growth curves, or mortality rates.

The inventory will start with delineations of stands for all forested areas. Photo interpretation will classify the stands for all recognizable characteristsics of the impacts listed for stratification of tree data, specifically: species, size class, and density. In addition, other factors will be added to the data base from overlays of resource inventories, specifically: visual quality objective, soil association, recreation opportunity spectrum, elk calving area, moose range, key range, diversity, watershed. Other factors that will be determined for each stand is logging method, accessibility, and operability.

These factors will not affect the stratification for tree data collection, but are important for management decision. The on-the-ground data collection will contribute: Habitat Type, understory density, regeneration density, slope,serotiny, site, soil stability, and all standard data from the R-2 FSM 2409.26d Silvicultural Examination Handbook.

Objectives of this re-inventory are:

1. Establish a base for acreage accountability for all areas within the gross boundary of the Bighorn National Forest.

2. Establish a base of site-specific tree data to be updated and maintained continuously, providing current, accurate information for Land Management Planning and National Assessments.

3. Provide a base for multi-resource data collection and storage.

4. Provide statistically-sound data for calculation of the Biological Growth Potential and Allowable Sale Quanitity.

5. Update existing permanent remeasurement plots for long-term calculations of mortality and yield.

II. INVENTORY PROCEDURES

A. Sampling Design

The sampling design is described in detail in Appendix A. This reinventory will utilize a two-phase sampling procedure consisting of a 100 percent area sample based on stand delineation of land use and timber stands on aerial photographs (photo sample--first phase) and field data collected from sample stands (second phase).

B. Mapping and Stratification

1. Timber Land-Use Classification Map

Mapping is the first step and a major part of the inventory process. The timber land use classification map and the stand map form an integral part of the data base from which Forest land management planning can make assessments and decision. These maps provide information on areas and locations of various management conditions and constraints and reflect overall management direction. They give the manager reasonable estimates of specific treatment opportunities and priorities, as well as a useful overview of long-range timber management needs.

The timber land use classification map describes the total forest area in relation to the land, land management objectives, suitability and availability for timber management, and other multiple-use factors affecting the opportunity to use the resource. The land use classification system and definitions provided in FSM 2413, I.D. No. 73 and FSH 2409.26d will be used to develop this map. Exhibit 1, Appendix B, presents the system in an easily visualized hierarchial form. It gives summary definitions of each category or component along with the code for each which is used in FSH 2409.26d. Exhibit 2, Appendix B, presents forest subdivision codes and definitions.

These codes are to be used to identify on the map the categories, components, and subdivisions. Other forest criterial decisions for development of this map are as follows:

1. The map shall be prepared on the USGS 1:24,000 orthophoto base maps using the forest 1:24,000 aerial photographs (1979 color infra-red).
2. Productive forest land must have evidence (stumps) of having supported commercial tree vegetation in the recent past.
3. Old burns and clearcuts with history of repeated reforestation failures shall be classified as technologically not suited. Use guidelines for backlog regeneration survey.
4. The pinyon-juniper and oak types are classified as non-productive forest land.
5. Proposed recreation sites not planned for development in the next ten years shall be classified in whatever component they would otherwise fit into if not designated for recreation development.

6. Non-stocked areas verified for reforestation will be classified in the component in which they would be classified if the areas were now stocked.

7. Capable and available lands which have slopes in excess of 40 percent and meet the criteria for cable logging will be classified as cable logging areas within the suitable[1/] component. The criteria for cable logging areas are shown in Exhibit 3, Appendix B. Capable and available lands which have slopes in excess of 40 percent and do not meet these criteria will be classified in the unsuitable component.

2. Stand Map

The second map is a Forest stand map. This map will be produced from the District stand maps. The master stand index maps will be prepared on frosted acetate overlays over the orthophotos. During the period of this reinventory, District stand maps will be completed. Criteria for preparing stand mapping may be found in Appendix B.

A stand is defined as "A plant community, particularly, but not necessarily, of tree, possessing sufficient uniformity in regard to timber type, age class, risk class, vigor, stand size class, and stocking class as to be distinguishable from adjacent communities and thus form a silvicultural or management entity. Further, such a plant community should be characterized by occupying a topographic position so unique in soils, aspect, slope, precipitation, and solar insolation as to affect species composition, tree growth, maturity, and regeneration in a constant degree."

1/ Suitability is only tentative and final suitability will be determined during the planning process.

The stand is the smallest unit for which timber data will be collected and silvicultural prescription prepared.

3. Stratification

The sampling strata used are based on land use or component and further breakdown of the Forest related to forest type and stand size class.

Because this sampling design is a two-phase process, some PI classification error is expected--some land classifications may be different on the field sample than on the photo phase. That is, some productive forest land likely will be found in unproductive strata, and some unproductive and/or nonforest land likely will be found in productive strata. It should be noted that once a stand is classified into a strata, it remains in that strata even though the field classification is different from the original photo classification. A common error to be avoided is to change the strata classification when the field sample indicates a different classification. However, the PI strata total area will be corrected based upon the field sample types actually found.

For this reinventory the above error for the strata in components 500 and 600 will be greatly reduced as these strata will be 100 percent field verified through Stage II process. Thus, these strata areas are known except for some additional areas that may come from other strata incorrectly photo interpreted.

Stands will be selected according to the following areas:

STRATUM BY FOREST TYPE, STANDSIZE, AND STAND DIAGNOSIS

FOR TENTATIVELY SUITABLE PRODUCTIVE FOREST LAND

(500 and 600 series components)

	Minimum Number of Samples
LP SAW	10
LP POLE	10
LP SS	10
LP NS	10
SF SAW	10
SF POLE	10
SF SS	10
SF NS	10
DF SAW	10
DF POLE	10
DF SS	10
DF NS	10
PP SAW	10
PP POLE	10
PP SS	10
PP NS	10
ASPEN SAW	10
ASPEN POLE	10
ASPEN SS	10
ASPEN NS	10

(The Forest can narrow these down.) NO!

STRATUM BY FOREST TYPE AND STANDSIZE

FOR TENTATIVELY UNSUITABLE PRODUCTIVE FOREST LAND

(700 and 800 series components)

	Minimum Number of Samples
LP SAW	5
LP POLE	5
LP SS	5
LP NS	5
SF SAW	5
SF POLE	5
SF SS	5
SF NS	5
DF SAW	5
DF POLE	5
DF SS	5
DF NS	5
PP SAW	5
PP POLE	5
PP SS	5
PP NS	5
ASP SAW	5
ASP POLE	5
ASP SS	5
ASP NS	5

STRATUM BY FOREST TYPE

FOR TENTATIVELY NONPRODUCTIVE FOREST LAND

(900 series)

	Minimum Number of Samples
LP, SF, PP, DF	10
Aspen	10
Pinyon Juniper	10
Oakbrush	10

STRATUM FOR NON-FOREST LAND AND WATER

(100 and 200 series)

Non-Forest (200 series)	10
Water (100 series)	10

When the stand mapping is complete the stand map data will be entered into each DISTRICT STAND DATA BASE. Mapped data will be ground verified and corrected by ongoing Stage II surveys until an EXTENSIVE DATA BASE is created for processing the Stage I inventory.

An EXTENSIVE DATA BASE is created by loading current DISTRICT STAND DATA BASES into a forest-wide EXTENSIVE DATA BASE. Inventory strata will be from the EXTENSIVE DATA BASE. Refer to Chapter 80 of the Silvicultural Examination and Prescription Handbook (FSH 2409.26d) for further explanation of STAND and EXTENSIVE DATA BASES.

B. Field Sample Size and Selection

The photo sample will inventory the gross forest area but only the net non-reserved National Forest areas including deferred will be field sampled. Reserved areas will be delineated and mapped but NOT field sampled.

The field sample size will be primarily determined by using a grid (see Appendix A sample selection). If the required minimum number of samples in a strata are not selected, additional stands will be selected.

Resource Evaluation accuracy standards are not the limiting consideration in this inventory since they are not restrictive enough to provide the kind of information needed to meet the objectives of this inventory. Rather it was necessary to use experienced information to determine the size of the field sample.

Much of the stratum area will be known from Stage II examinations especially in the suitable components (500 and 600). This will greatly increase the accuracy of the inventory.

The tentatively "suitable" component (500 and 600 series) will have Stage II survey data collected (level 923 survey) on all stands. A minimum of 10 sample stands will be selected from each forest type and standsize for compilation of data for the reinventory at survey level 943.

The tentatively "unsuitable" component (700 and 800 series) will have Stage II survey data collected at level 943 survey on a minimum of 5 stands selected per forest type and standsize.

For all other components sample stands will be selected at a lower intensity with level 943 survey on commercial tree species stands, a level 923 survey on other forested stands and level 913 survey (re-examined in the office) on remaining stands. If there is a change of land use to the productive category a level 943 survey will then be taken. Field samples in these remaining components are meant to correct any photo interpretation error and not to provide a valid field sample for volume, number of stems, etc., determination.
For a listing of strata and minimum number of samples taken see Mapping and Stratification.

Ongoing Stage II inventory tree data will be stored on the Forest STAND SUPPORT FILES. Ground sample data used for the Stage I inventory will be moved from STAND SUPPORT FILES to an EXTENSIVE SUPPORT FILE (Vargen tape).

D. Reinventory Field Procedures

Crews will locate sample stands on the ground from aerial photos. Several sample points will be tallied depending upon the size of the stand. At each sample point, a variable radius plot will be taken for trees 5 inches DBH and larger and fixed radius plot will be taken for trees less than 5 inches DBH.

Stage II stand examination procedures will be followed for all field work. These procedures are described in the Silvicultural Examination and Prescription Handbook (FSH 2409.26d) for Chapter 20 Stand Data and Chapter 30 - Tree Data.

E. Accuracy Standards and Quality Control

Accuracy standards set by Resources Evaluation are indicated below. These are minimum accuracy standards Resources Evaluation must meet. It is essential, however, to make sure sampling intensity is adequate to meet these error limitations.

Resources Evaluation Accuracy Standards (West)		Percent
Allowable volume error/MM cubic feet	(SE)	10
Allowable CFL area error/MM acres	(SE)	3
Allowable NCFL area error/MM acres	(SE)	10

Quality control of the stand mapping and field data collection will be the responsibility of the Forest Supervisor (FSH 2409.26d, Chapter 40). This also includes the reviewing, checking, and updating of stands previously inventoried. These stands if their data is to be included in the inventory need to be checked for quality of data, proper type of survey (943), and updated by field visits if any changes have been made due to treatments, natural occurrences, etc.

F. Area Calculations and Control

Gross and net area control will be the areas published in the Forest Service publication "Land Areas of the National Forest System." Date of publication to use will be the year the Forest stand map is completed.

Net and gross acres computed for compartments will total to the published Forest totals. The compartment totals will provide the control for stand areas.

Areas for individual stands will be determined from the overlay stand map. Once determined stand areas will be summarized by compartment and county and adjusted to known compartment and county totals as outlined in FSH 2409.26d, Chapter 80.

Adjustment will be made in the Forest's EXTENSIVE FILE. If so desired by the Districts, stand areas on the District STAND DATA Bases could be updated with these adjusted stand areas.

The entire Gross National Forest area (area within the Forest's boundary) will be delineated. Other ownerships will be blocked out and shown on the standfile as individual stands. The net inventory area for sampling will be the gross National Forest Area minus other ownerships minus reserved areas.

Quality control for the compilation of the reinventory will be the responsibility of the Regional Office.

The Forest EXTENSIVE DATA BASE will be adjusted so that stand areas summa-ized to compartment and county totals will match known net and gross areas.

The following is a list of reserved and deferred areas and acreages by Forest:

ACREAGE OF RESERVED AND DEFERRED AREAS

AS OF OCTOBER 1, 1982

BIGHORN NATIONAL FOREST

Reserved Acres

Area Name	NFS	Other Lands	Total
Cloud Peak Primitive	136,905		136,905
Bull Elk Park Natural Areas	719		719

Deferred Acres

Wilderness Study Areas			
Piney Creek	23,550		23,550
Little Goose	37,760		37,760
Cloud Peak Contiguous	151,410		151,410
Rock Creek	51,200		51,200
Recommended Wilderness			
Seven Brothers	5,370		5,370

G. Growth and Mortality

Growth and mortality will be obtained by remeasuring a selection of original Fixed Radius permanent sample plots from each type and stand size strata of significance. (Appendix C.) Future growth and mortality in subsequent reinventories can be measured from these Fixed Radius Plots.

H. Defect Study

In order to furnish data for adjustment of the timber inventory gross Scribner, international and cubic foot volumes a separate net volume study will be made.

A subsample will be selected at a number of the inventory sample locations. This will provide an adequate sample of the major species.

The tree data will be collected and run through the computer routine NETVOL. See Appendix D.

III. DATA PROCESSING

All data used by the reinventory will be office and machine edited before actually being compiled.

When the District STAND DATA BASES are completed, they will be copied into a Forest EXTENSIVE DATA BASE. This Extensive file will be adjusted to the known areas and stratum areas will be summarized.

The field data from the sample stands will be processed through the standard Stage I/II processing program called VARGEN. Output from VARGEN will be standard stand printouts and a variable generator tape (EXTENSIVE SUPPORT FILE).

This tape along with the uncorrected stratum areas from the EXTENSIVE FILE will be inputed in FINSYS-2 to produce the Standard Reinventory Tables (see Appendix E, Exhibit 1).

IV. ANALYSIS

Data processing will be consistent with Forest survey procedures and will meet National analysis needs as outlined in FSM 4813. The data used in this inventory will be compiled from Stage II sample points and stand data. Several computer programs and data bases will be used, such as "VARGEN" (edits field data, builds per-acre stand tables, builds standard field data tape), "FINSYS" (summarizes field data tape into dimensional output table), District "STAND DATA BASE" (dynamic data base system for storage, update, and retrieval of District stand summaries), "STAND SUPPORT FILES" (store raw Stage II tree data, EXTENSIVE DATA BASE (static data base for Forest inventory created from District Stand Files, and "EXTENSIVE SUPPORT FILE" (tree data samples selected from stand support file and used for the Forest inventory).

Statistical Analysis for Forest Planning Needs

The compilation procedure will handle statistical computations and interpretive computations separately. The timber statistics required by the Washington Office of the U.S. Forest Service will be produced in accordance with Standard statistical procedures (see Forest Survey Handbook 4813.1). The high intensity of both photo and field sampling will permit post-stratification to array the timber growing base land by significant condition classes for which product outputs can be established.

A condition class shall consist of all ground samples grouped as a single analysis area. The condition class, therefore, will consist of very homogeneous stands. All data within one condition class will be cumulated

to provide condition class averages. These averages will then be used to develop the allowable sale quantity. Total volumes and allowable sale quantities by condition classes will be developed.

The standard set of forest-wide inventory tables in Appendix F will provide general information on forest cover types, stand size class, age class, etc. Per-acre stand tables to represent specific condition classes needed for Forest planning will be produced by post-stratification of the inventory data. Per-acre stand tables will be built using the "combined stand printout option" of the VARGEN program. (All analysis areas needed to produce a Forest Plan cannot be anticipated during the inventory phase.)

Computerized yield simulations using condition class data will develop condition class yields that can be employed in a tabular scheduling through time, reflecting a high-level management regime. Management regimes will be developed for each timber management alternative displayed in the Forest Land Management Planning Documents.

Allowable sale quantity and base harvest schedule for the first decade as allocated by FORPLAN can be displayed by condition classes for each Forest and Ranger District.

The annual programmed sale quantity can then be developed by selection of stands for treatment within the condition class allowable sale quantities allocated by FORPLAN. Selection of stands by condition class for cutting provides the flexibility to obtain distribution of the harvest over the entire Forest and achieve a balance of age classes.

V. SCHEDULE OF WORK, COSTS, RESPONSIBILITIES

The re-inventory is to be a coordinated effort between the following:

A. Bighorn National Forest

Photo interpretation and photogrammetry, stand delineation and mapping, acreage accountability, non-timber resource inputs, data collection (either by Force Account or Contracting), analysis, updating of Forest Plan and Statement.

Key Personnel	Duties
Robert Damson, Forest Silviculturist	Planning, technical assistance, training, quality control, analysis
John Almond, Timber Planner	Project leader, photo interpretation, coordination of data collection quality control.
Charles Simon, Timber Staff	Planning, coordination, Management Team member

B. R-2 Regional Office

Robert Jackson, Supervisory Forester	Planning, coordination, liaison
Daniel Greene, Supervisory Forester	ADP coordination, Management Planning Service
Mel Mehl, Forester	Inventory design, data processing, coordination

C. Intermountain Forest and Range Experiment Station

J. David Born, Research Forester — Planning assistance, technical consulting, coordination

(Costs are estimated for the Bighorn National Forest only, 1981 dollars)

Fiscal Year	Responsibility	Task	Estimated Cost - $ M
1982	B.N.F., RO	Complete, approved	$ 5
	I-M.F.R.E.S.	Re-inventory Plan	
	B.N.F.	Process Orthophotos for base maps	8
1983	B.N.F.	Start P.I. work and field checks, train assistant, allocate acreage to sub-compartment level, Level I State II inventory	72
1984	B.N.F.	Complete P.I. work and field Level I inventory	15
	B.N.F., RO	Design sampling, assemble contract or train Force Account Crews	10
	B.N.F.	Award and administer contract or supervise Force Account Crews, collect data with quality control	170
	B.N.F.	Growth and Mortality, defect studies	20

Fiscal Year	Responsibility	Task	Estimated Cost - $ M
1985	RO	Process data	---
	B.N.F., RO	Analysis, Yield simulations, FORPLAN	60
1986	B.N.F.	Update Forest Plan	20

The project will be funded from 032 and 037 funds.

VI. SAFETY

Safety practices will be stressed for all phases of the Forest inventory, but will be especially emphasized during the field phases. Each individual involved will receive training according to standard Regional guidelines in safety practices and will be cautioned and reminded throughout the working period. As in all Forest Service jobs, accident prevention and safety code compliance shall take precedence over immediate job production.

BIGHORN NATIONAL FOREST REINVENTORY

APPENDIX - A

Sampling Mechanics

A. Sampling Design

The sampling design is a stratified two-phase sampling procedure. The primary phase is a 100 percent stand delineation on aerial photos with verification of the tentatively suitable strata by the 923 Stage II process. Each stand is classified by strata and its area is determined. The secondary phase, which provides estimates of location and tree attributes, is a field sample of stands. Stands are sampled for estimates of stand parameters. The secondary phase sample, which provides estimates of location and tree attributes, is obtained from ground observation taken on a subset of the primary phase delineations. The secondary phase sample is also used to adjust the total area of each strata for errors made in classifying stands into specific strata.

Stratified two-phase sampling in general, when properly applied is an efficient design. It can reduce the variance, when compared to other sampling designs, which results in either a smaller field sample necessary to meet a specified accuracy standard and/or it improves the reliability of the estimates of primary interest for a specified secondary sample size. Efficiency is obtained by selecting sampling strata along lines of recognizable land and/or vegetative characteristics that delineate areas of homogeneous management condition (stands). Further, these management conditions should relate to other items of interest such as volume, standsize class, productivity class, forest type, etc.

B. Field Sample Size and Sample Selection

Enough field samples will be selected in order to meet management planning needs and will therefore surpass Resource Evaluation accuracy standards. Based on past inventory experience in the Region, the average coefficient of variation between timber types on CFL is 60 percent. For management planning purposes, it is recommended that at least 20 percent standard error be obtained in each management strata.

Two methods of selection will be used to select sample stands. An initial selection will be made using the REDAB Grid (see Appendix F). This is essentially the same as placing a grid over the entire forest. Grid intersection points based on Universal Transverse Mercator (UTM) Location System are located on 1:24,000 quad maps at an interval of about 11,596 feet. The final grid, composed of the secondary A and B grids, will be 45^{o} askew from cardinal directions, with each point representing about 3,087 acres on the average. The secondary A and B grids with points 5,000 meters apart in cardinal directions for each grid. The point will then be transferred to the typed photos. The stand in which the grid point falls will become a sample stand. Supplemental samples will then be added to strata where necessary to meet minimum sample size requirements.

About 200 tentatively suitable (Series 500 and 600 component) and 100 unsuitable (Series 700 and 800) and 60 nonproductive (Series 900) sample stands will be selected.

The actual numbers of samples will depend upon the stands selected and supplemental stands added.

A minimum of 10 sample stands will be sampled in the 500 and 600 component and the nonproductive strata. A minimum of 5 will be sampled in the other forested strata (see listing of strata, section IIB).

Of the nonproductive sample stands selected, a subsample will be randomly selected so only the minimum number required will be sampled. All non-forest stands "hit" by the grid will be verified.

If additional stands are needed in a particular stratum to meet the minimum, they will be selected using the program PSELECT (see the element PSELECTINFOR of the file PROGRAM). If not enough samples are available in a particular stratum, for example the seed/sap and nonstocked stratum, the stratum will collapse into the next silviculturally similar stratum.

In both methods of selection, REDAB GRID or PSELECT, the samples are selected with probability proportional to size (PPS).

It must be noted that even though 100 percent of the stands in the suitable component (500 and 600 series) will have been ground examined (through the Stage II process), a sample of these stands will be selected based on the foregoing procedures for use in constructing stand structure and volume tables.

APPENDIX - B

Mapping

Two types of maps will be a product of this reinventory, a Timber Land-Use Classification Map and Stand Map. Both maps will be overlays on 1:24,000 USGS Orthophoto maps and prepared by the Forest. All land within the gross National Forest boundaries will be mapped. However, private land will be just blocked out and shown as private.

A. Stand Mapping

Stand mapping will be done in accordance with procedures specified in FSH 2409.26d, Chapter 10.

Stand will be delineated on 1979 aerial photography and transferred with appropriate equipment to an overlay map on the Timber Atlas Orthophoto-quad Map. Stands will not cross timber land-use classification boundaries. A stand that is located in two different components shall be designated as two stands, one in each component.

Those stands on which Stage II Stand Examination has been done to date shall be placed on the stand map overlay first and classified to forest type. As Stage II examinations are completed each stand shall be classified and recorded.

Major changes in stand condition occurring between the date of the aerial photography and the date of reinventory as a result of natural phenomena or silvicultural treatment will be updated on the map.

As each stand is delineated or updated, a master control list form will be filled out. (See FSH 2409.26, Chapter 20.) A proper update code for the stand will be determined. The proper code is important. If, for example, an existing stand was being updated for just area, all the tree data on the STANDFILE for that stand could be lost.

Once these forms are completed they will be office edited and sent to the Regional Office to be keypunched, processed, and entered into the appro-priate District's STAND DATA BASE.

Exhibit 1

LAND USE CLASSIFICATION FOR TIMBER MANAGEMENT

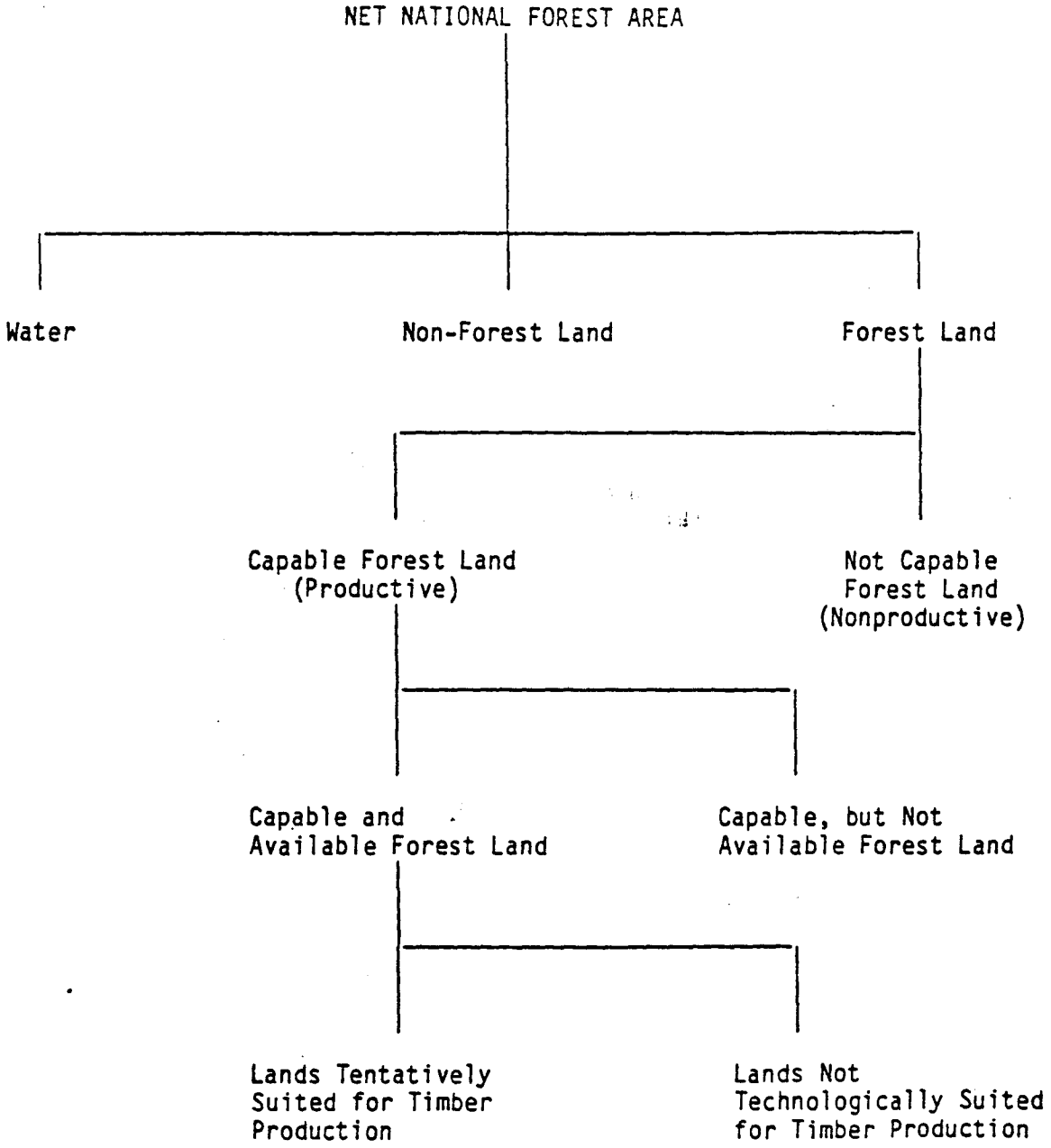

NET NATIONAL FOREST AREA
Water
Non-Forest Land
Forest Land
Capable Forest Land (Productive)
Not Capable Forest Land (Nonproductive)
Capable and Available Forest Land
Capable, but Not Available Forest Land
Lands Tentatively Suited for Timber Production
Lands Not Technologically Suited for Timber Production

Exhibit 2

MAP LEGEND

Standard Land Use Classification for Timber Management (Reference R-2 Silvicultural Examination and Prescription Handbook, 22.6).

000 Private

100 Water

200 Nonforest

Not Capable (nonproductive) - 900 Series

910 Oakbrush
920 Pinyon-Juniper
930 White pines
980 Other noncommercial species
990 Commercial species on sites not capable of producing 20 cubic feet/acre/year

Capable But Not Available - 300 and 400 Series

310 Productive Reserved
410 Productive Deferred
490 Productive Administratively Withdrawn
491 Research Natural Area

Capable and Available - 500 - 800 Series

Suitable - Full Yield

510 Roaded Upland Forest
511 Roaded Tractor Logging Area
512 Roaded Cable Logging Area
520 Unroaded Upland Forest
521 Unroaded Tractor Logging Area
522 Unroaded Cable Logging Area

Suitable - Modified Yield

620 Riparian Forest
630 Ski Area
640 Visual Management Emphasis
650 Wildlife Habitat Emphasis
660 Watershed (Water Quality Emphasis)
670 Cultural Resource Site

EXHIBIT 3

CRITERIA FOR CABLE LOGGING AREAS

The following criteria are applicable to a live skyline system using a two-drum mobile yarder and mechanical carriage. This is the only type of system used to date in R-2 to any significant degree, and the type most likely to be employed in the near future.

1. The area must allow for road construction at or near the brow of the slope so as to keep downhill skidding to a minimum.

2. If full bench roads are needed to log the area, there must also be room to build landings.

3. Maximum slope distance is 1,000 feet.

4. Convex slopes are generally not suitable for cable logging. Also, slopes should not have cliffs, rock overhangs, or other significant irregularities.

5. The lower portion of the slope opposite the one being logged should have trees suitable for use as tail holds or spar trees. If such trees are not available, there must be adequate access to the bottom so that portable tail holds or spars can be used without causing soil damage or other resource degradation.

6. Cable logging areas should be in the modification component of the Visual Management System because of the need for skidding corridors.

7. Volume of timber to be removed per entry must be at least 7 MBF per acre.

APPENDIX - C

Growth and Mortality

I. INTRODUCTION

Growth and mortality estimates will be a product of this reinventory. The estimates should come from remeasurement of 1/5 acre fixed plots established in 1958.

The growth estimate from the 10-year radial growth estimates from the reinventory stand samples represent a larger and more diverse sample. Any difference of growth estimates from the reinventory plots and the growth estimate from the remeasure plots will be closely analyzed.

Mortality estimates will come strictly from remeasured data. Remeasurement on fixed plots provides the best estimate of mortality because in Stage II procedures the actual time of death is unknown.

Growth and mortality data will be provided on a forest-type basis and not on an individual tree basis. Also, estimates will not be provided by site index mainly due to the greater expense involved by the need for a much larger sample. Gross growth coefficients will be calculated and put into program "GROW."

II. SAMPLE SELECTION

A. Sample Size

The sixty 1/5 acre plots will be remeasured. Nonstocked stands will be excluded. Past experience has shown that remeasuring nonstocked stands has provided very little if any additonal data.

An additional two plots per forest type and size will be selected to use as alternates in case the initial ones are not locatable.

B. Sample Selection

The list of available 1/5 acres plots will be updated for type and stand-size.

III. DATA COMPILATION AND ANALYSIS

A. Editing and Keypunching

All remeasurement plot sheets will be office edited by the Supervisor's Office before being sent to the Regional Office. They will again be office edited before being keypunched. Once keypunched, the data will be run through the edit option of the REMESR program.

B. Compilation of Data

Program REMESR will be used to process the remeasured data. Documentation on its use can be found on the INVADP*PROGRAM file.

Cubic volumes are calculated to a 4-inch top DIB using Kemps formulas and Scribner and International volumes are computed to a variable top using Kemps formulas. Tables of Growth (gross and net) and Mortality per acre with corresponding standard error and confidence interval statistics are standard program output. This table is broken down by forest type, stand-size, and volume type for gross growth, mortality, and net growth. "REMESR" also produces per acre location summaries, tree summaries, and punched growth summaries for building growth prediction equations.

B. Program Modifications

Site Index calculation subroutines will be added to "REMESR".

C. Final Results

The growth table produced by "REMESR" and the growth table produced from preliminary stand runs (VARGEN) will be compared. Appropriate adjustments will be made to the variable generator tape. There is an option (14) in the VARGEN program that can be used to calibrate the mortality rate estimated from the remeasured plots. This assumes that the growth estimate from the 10-year radial growth measurements is valid. There is no VARGEN option to adjust the growth rate from the reinventory plots.

Gross growth coefficients will also be built and put into program GROW.

The regression coefficients are calculated by program REGRESS. Input into program REGRESS is remeasurement growth data output from program REMESR. Also, if more samples are needed, growth trees from the reinventory plots can be used. This data is pulled off the variable generator tape by program GROWTHDATA.

The coefficients can be analyzed using program EQACHK. Once a satisfactorily set of growth coefficients are produced they will be input into program GROW, subroutine GROWCOEF.

APPENDIX - D

DEFECT STUDY

I. SELECTION OF NET VOLUME SAMPLE

The sample for the net volume study will be selected as a subsample of the reinventory locations. This should assure us of getting an adequate sample of the primary species occurring on the Forest. Growing stock trees will be selected and no cull trees will be included in the sample.

Sample Selection - Locations

Destructive sample locations will be selected basically from grid points on the REDAB Grid. A list of qualifying grid points will be made. For a grid point to qualify it must fall in productive nonreserved forest land. The destructive sample locations will be selected from this list. An interval will be selected, for example, every fourth point that will provide approximately 60 destructive sample locations.

An additional 10 destructive sample locations will be selected as alternatives in case some of the inital locations cannot be destructively sampled.

II. FIELD PROCEDURES

A. Establishing Net Volume Study Points

1. Responsibility - Net volume (defect) study points will be established independently of the inventory and measurements will be taken by a Force Account Crew.

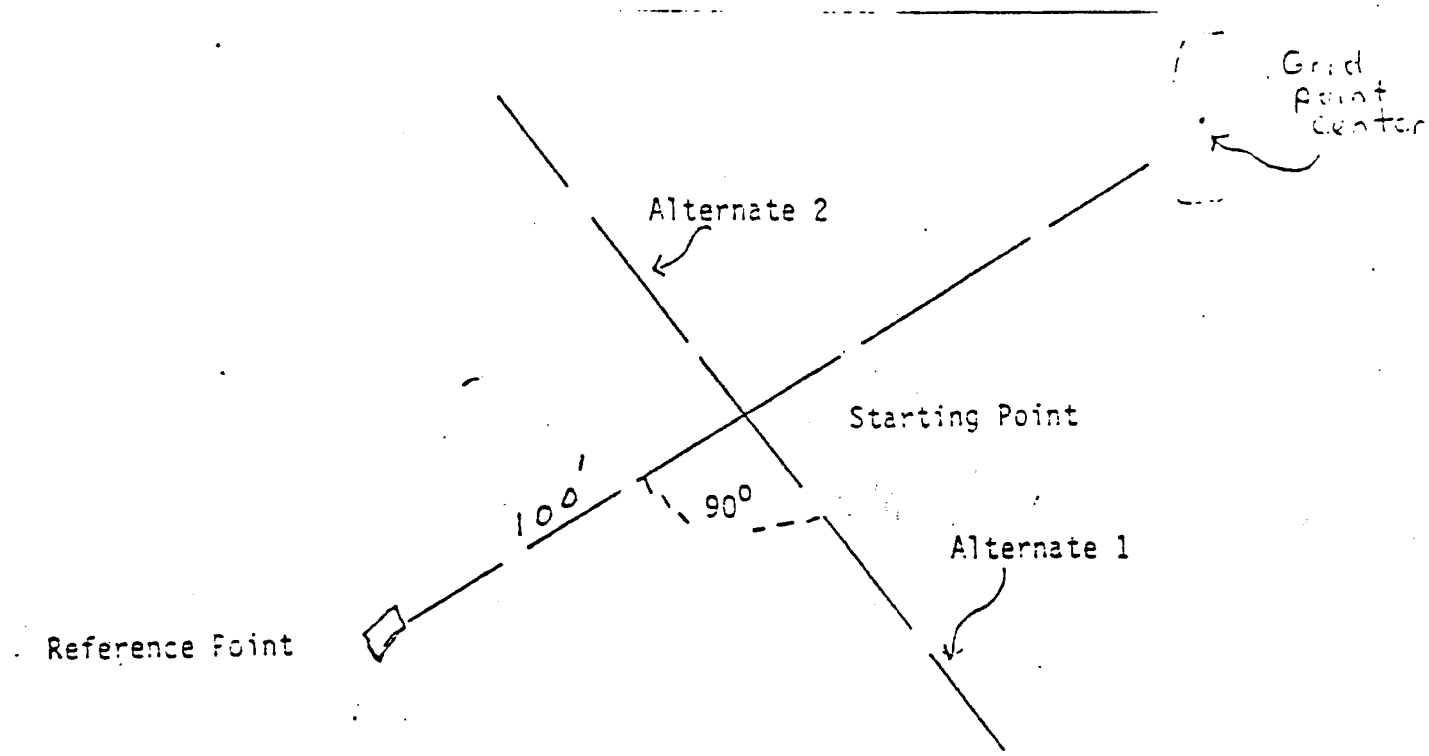
2. Procedures

a. The grid point will have been transferred in the office from the map to the proper aerial photos and pinpricked.

The grid point will be located on the ground by establishing a Reference Point (RP) and determining the azimuth and distance to the grid point.

b. Distance from the Reference Point to the grid point will be taped and the starting point for the defect study line transect will be at the end of the first 100 foot interval that falls within productive forestland. From this starting point and along a line to the grid point all trees 5'0" and larger within the range of the 20 BAF will be tallied until 7 trees have been selected. No trees will be selected that are within 100 feet of the grid point. The distance and azimuth to the starting point and to the ending point and the number of trees tallied will be recorded on the net volume location sheet. If there is insufficient distance on the line to grid point to obtain the desired number of trees, additional transects will be run on alternate lines 1 and 2 (see diagram). The distances to be run on alternate lines will not be tallied after the alternate lines have been run, the number tallied will be considered sufficient for the sample.

GRID POINT DIAGRAM



G-2

3. Location/Stand Header Item Record Sheet (See Exhibit 1)

A location record sheet will be prepared for each defect study plot. It will be identified by a red band across the top of the form. This form will be transmitted to the Regional Office.

Only the following items on the loader cards need to be filled in:

a. Location number. Use the same number as assigned to the inventory location.
b. Use State code.
c. Survey Unit. Forest and District code number.
d. County. Code from Handbook.
e. Sample kind. Use code 7.
f. Date of survey. Month and year.
g. Ground Land Use - must be productive forest land.
h. Ground type and SSC. Must be commercial type.
i. Description. From inventory plot record.
j. Course to sample location. Record azimuth.
k. Field Crew. Initial and last name.
l. Photos. From inventory plot record.
m. Reference Point.
n. General Statement. Record number of selected trees.

B. Destruction of Study Points

1. Responsibility. The Defect Study Crew will be responsible for locating and measuring study points and for editing the collected data for errors before leaving the sample location.

2. Crew Composition. A three-man crew will be employed consisting of of the following personnel:

   a. Crew Chief. A Forester or Forestry Technician experienced in inventory procedures. This individual must be impressed with the fact that taking net volume data is a thoroughly professional responsibility because it can affect volume estimates for the National Forest by hundreds of thousands of cubic feet.

   b. Feller-Recorder. The crew member must be skilled and experienced in felling and bucking trees, and in the use and maintenance of a chain saw. He will fell sample trees and make cross-sectional cuts wherever necessary. In addition, he will assist in recording measurement when the Crew Chief is occupied.

   c. Estimator. This crew member is primarily responsible for taking all measurements on felled trees. The estimator will be a qualified scaler.

3. Procedures

a. Upon arrival at the transect, the Crew Chief will check the tree classification before felling. Only growing stock trees will be felled and measured. He will supervise felling and dissection of sample trees and be available to answer questions about correct procedure.

b. The transect will be completed in the order that it was established.

c. It is not necessary to cut and measure all seven trees on a transect to consider the transect completed. The transect will be considered completed at the end of a normal work day if five trees have been felled and measured.

C. Data Collection Procedures

Data will be collected in accordance with the methods described in the Silvicultural Examination and Prescription Handbook, FSH 2409.26d, Chapter 94.

IV. ANALYSIS OF NET VOLUME DATA

A. The data collected is in the "NETSVL" format and will be keypunched by the Regional Office. The data will be office and machine edited and then processed through NETSVL.

B. Output from NETSVL will be used to build forest merchantable tables. A Merch Factor Form (Exhibit 2) will be filled out and added to the PROGRAM file as elements for each Forest.

EXHIBIT 1

(FSH 2409.26G)

COMPARTMENT	STAND	FOREST
A		C
1-6	7-10	11-12

USDA, FOREST SERVICE

LOCATION/STAND HEADER ITEM RECORD SHEET
(STAGE I/II)

IDENTITY

CARD TYPE	TITLE
1	DEFECT STUDY
13	14-80

FIELD DATA

CARD TYPE	LOCATION IDENTIFIER	REGION	GROUND LAND USE CLASS	SUBCODE	TYPE OF SURVEY	DATE OF SURVEY	SAMPLE KIND	NO. OF SAMPLE POINTS	BASAL AREA FACTOR	FIXED PLOT SIZE	GROWTH PERIOD	SLOPE PERCENT CLASS	SLOPE POSITION CLASS	ASPECT	EROSION CONDITION CLASS	PLANT COMMUNITY	STAND ORIGIN	SEED SOURCE
2	1				F													
13	14	15-16	17	18-20	21-24	25	26	27-29	30-31	32-34	35-38	37-39	40	41	42	43-44	45-51	52	53

POLITICAL DATA

CARD TYPE	STATE	COUNTY	DISTRICT	OWNERSHIP	WATERSHED		SOURCE PREVIOUSLY USED ON FORM REV. C	CAPABILITY AREA	SITE LINK	MGMT	SPECIAL UNIT CODE
4	B	D	C	11							
13	14-15	16-18	19-20	21-22	23-30	31-32	34-51	52-63	64-67	68	69-72

PHOTO AND MAP DATA

CARD TYPE	PHOTO IDENTIFICATION		PI LAND USE CLASS	PI TYPE	PI STAND SIZE CLASS	LEGAL LAND DESCRIPTION	SOURCE PREVIOUSLY USED ON FORM REV. C	ELEVATION MIDPOINT	SOURCE PREVIOUSLY USED ON FORM REV. C
6		I	G	H	H				
13	14-22	23-29	30-32	33-34	35-36	37-46	47-52	53-55	56-76

AREA DATA

CARD TYPE	STAND AREA ACRES		COMPONENT CODE	SOURCE PREVIOUSLY USED ON FORM REV. C
8				
13	14-17	18-19	20	21-23	24-59

R2-2410-7a
(Rev. 6-81)

LOCATION/STAND HEADER ITEM RECORD SHEET
(STAGE I AND STAGE II)

STAGE I/STAGE II NON-PUNCH INFORMATION:

PLACE NAME _____

FIELD CREW ESTIMATOR K RECORDER _____

FIELD EDIT NAME _____ DATE _____

GENERAL STATEMENT: N _____

OFFICE EDIT: NAME _____ DATE _____

OTHER STAGE I/STAGE II NON-PUNCH INFORMATION:

I

STAGE I NON-PUNCH INFORMATION: J

REFERENCE POINT: SPECIES _____ DBH _____ TRAVEL DESCRIPTION _____

COURSE TO LOCATION CENTER: AZIMUTH M DISTANCE _____

WITNESS TREES: X—SPECIES _____ DBH _____ AZIMUTH _____ DISTANCE _____

Y—SPECIES _____ DBH _____ AZIMUTH _____ DISTANCE _____

GPO 835-284

EXHIBIT 2

NTRCH FACTORS FOR INPUT TO PROGRAM VARGEN AND STAND

FOREST _____

WORKING CIRCLE _____

DATE _____

		WF	OTH FIR	JUN-IPER	OTH SPR	BLUE SPR.	OTH PINE	PIN-YON	LP	PON	DF	ASP	OTH HWD.
		LL1	LL2	LL3	LL4	LL5	LL6	LL7	LL8	LL9	LL10	LL11	LL12
Cubic growing stock													
5.0-8.9	cf11												
9.0-20.9	cf12												
21.0-30.9	cf13												
31.0-40.9	cf14												
41.0 plus	cf15												
Cubic sound culls													
5.0-8.9	cf21												
9.0-20.9	cf22												
21.0-30.9	cf23												
31.0-40.9	cf24												
41.0 plus	cf25												
Cubic rotten culls													
5.0-8.9	cf31												
9.0-20.9	cf32												
21.0-30.9	cf33												
31.0-40.9	cf34												
41.0 plus	cf35												
Scribner growing stock													
9.0-20.9	bs12												
21.0-30.9	bs13												
31.0-40.9	bs14												
41.0 plus	bs15												
7.0-7.9	bs16												
8.0-8.9	bs17												

D-12

APPENDIX E

DATA PROCESSING

I. INTRODUCTION

All data processing will be done on the Univac 1180 located in Fort Collins, operated by USDA-FCCC. Currently all programs are written in Fortran V and the Forest and District data bases are set up under System 2000. For data processing of growth and mortality data and the defect study see appropriate appendicies. For current specific information concerning editing and processing of data, file creation and naming conventions, and data base (System 2000) loading and management see 2409.26d, Chapter 70.

Information on using the mentioned standard processing programs can be found in the general systems information file PROGRAM.

II. PHOTO AND DISTRICT STAND MAP DATA

A. Editing

As the master control lists are filled out, they will be office edited and sent to the Regional Office. At the Regional Office they will be re-edited and sent out for keypunching.

Once keypunched, the Regional Office will put data into files by Forest and District. The files will be named with the standard naming procedure for Stage II stand examination data.

The data will then be machine edited by the VARGEN program using the "edit only" option. Information on the options available and how to use the VARGEN program are found on the element VGMAININFO of the file PROGRAM.

B. Processing and Loading into District Stand Data Base

When the data is clean, it will be run through the VARGEN program with the production option. Output from this run will be a summary card for each stand. The summary cards are output to file, this file can then be loaded into the appropriate District's STAND DATA BASE.

After all the stands for a particular District have been loaded into the STAND DATA BASE, a summary of area by compartment will be made.

C. Extensive Data Base

When the District STAND DATA BASES have been loaded completely, a Forest EXTENSIVE DATA BASE will be created. The STAND DATA BASE from each District for a Forest will be loaded into the Forest's EXTENSIVE DATA BASE. (See FSH 2409.26d, Chapter 70.)

The Forest EXTENSIVE DATA BASE will be used for area control for the duration of the inventory cycle. (See FSH 2409.26d, Chapter 80, for more information.)

Adjustments will be made to make sure county areas equal known totals specified in section F. Program CNTYADJ will be used to make this adjustment. (See the element CNTYABJINFO on the file PROGRAM.)

Once the Forest EXTENSIVE File has been adjusted, area tables by owner, District and county will be produced using PITAB. (See the element PITABINFO on the file PROGRAM.)

An area table showing mapped (not yet corrected by field samples) area by strata will also be produced using PITAB. These area will become the stratum weights that are required by FINSYS-2. (Fill out Exhibit 3.)

III. FIELD DATA

A. Introduction

Sample stands with varying dates of ground examinations will be used in this reinventory. Stage II stand exams have been carried out on the Forest for a period of years. Some of these previously examined stands plus those that are yet to be examined over the next four years could be selected for sample stands for compilation of the reinventory.

To provide for a common date of inventory, a date will be calculated based on the weighted average of the field exam dates of the samples selected. This common date will be used as a date from which to grow the inventory forward.

Field data will be processed and handled according to FSH 2409.26d, Chapter 70, and compiled for the reinventory according to Chapter 90.

B. Editing

Field data will be handled through the standard Stage II procedure. The data will be edited in the field than at the Supervisor's level.

It will then be sent to the Regional Office using the standard transmittal sheets. At the Regional Office it will be checked and keypunched. Once keypunched it will be put into District files by Forest using the standard Regional file naming convention.

C. Processing of Field Data

Data will be processed by the standard Stage II process. As the stand data is processed, it is placed into District Support Files. The District Support Files contain the header and tree information in the same format as they were collected. Each stand is an element of the Support File.

When all the field work is collected for the reinventory, all stands selected for reinventory sample locations will be pulled off the proper District Support Files. Each stand will be an element of that file.

1. Stratum Weights

The field sample stands on an individual Forest basis will run through the VARGEN program using the production option. However, before this can be done some preprocessing needs to be done.

The sample stands need to be first counted by stratum. Program VGSTRAT (see VGSTDATINFO on file program) is used for this. Output is a listing of stands by strata. With this information and the area of each strata from summaries of the EXTENSIVE File, stratum weights of the area that each ground sample represents can be computed. The area of each stratum is divided by the number of field samples in that stratum.

2. VARGEN Processing

Once the stratum weights are known the data can be run through the VARGEN program. Subroutine CHANGE (see VGMAINFO on file PROGRAM) is

called to change the actual stand areas in each strata by the new stratum weight or area that the sample stand actually represents. CHANGE can also be used to make any other changes like ground land use before the VARGEN program does any calculations.

3. VARGEN Output

Besides stand printouts for each stand, a summary of all plot variables, a summary of volume and growth, a general plot information and stocking table should be produced. For the run as a whole a variable generator tape (EXTENSIVE Support File), a table summarizing area by type and standsize, and a growth and mortality table should be produced.

The Extensive Support File (variable generator tape) has all the per-acre summary plot values and individual tree data for each sample stand.

IV. CHECKS ON VARGEN PROCESSING

A. Individual stand printouts need to be reviewed to double check ground land use (see Exhibit 4). Such items as survey field, stand growth and site elevation need to be reviewed. Any changes are made through subroutine CHANGE. The VARGEN program will be rerun generating new printout tables and variable generator tape.

B. The summary listing of plot and tree variable is useful to double check actual calculations made by the VARGEN program. A sample of stand variables will be double checked.

C. The table showing type by area and standsize after the final VARGEN run will be the corrected areas. This table must be the same as the area by type and standsize produced later by FINSYS-2.

The growth and mortality table is compared with that from the re-measured plots. An analysis will be made to determine which of or/a combination of the two tables (see Appendix C) is appropriate.

V. FINSYS-2 COMPILATION

A. Introduction

FINSYS-2 is a Nationwide inventory program used to compile inventory data into user-specified tables. For procedures on using FINSYS, see present document on file at the Fort Collin's office or from the Intermountain Station. The FINSYS program is on the Univac 1108. For more information on using FINSYS, table labels, and general runstreams, see the file FINSYS-2. For a list of Standard Tables and Labels see Exhibit 1 and Exhibit 2.

B. Compilation

For this Forest reinventory table option 3 constructing output tables of sampling unit means and their variances over sets of sampling units will be used. Output option 3 specifying that data are to be processed as a stratified random sample with known weights will be used.

The variable generator tape created from the latest VARGEN run will be used as input to FINSYS. A listing of variable locations on the tape and their definitions is in the PROGRAM file element VGMAINFO.

Before the variable generator tape can be input into FINSYS-2, it must be sorted by strata. Sorted in the same order as the stratum weights are

listed in the FINSYS-2 run. Program VGSORT is used to do this. At this point changes to the stand items on the tape can be made using VGSORT (see element VGSORTINFO on the file PROGRAM).

VI. PROCESSING FOR MANAGEMENT PLANNING

After the individual stand printouts and the standard inventory tables are completed, they will be reviewed by the Forest timber resource planner.

Per acre values by forest-type, standsize, and condition class (as requested by the Forest) will be produced. Sample stands will be grouped by standsize type and condition class. With the data on the variable generator tape the stands in each group will be put together and run through the VARGEN program with the combine option. The combine option essentially takes all the stands in a group and produces per acre stand tables. The output is one stand printout for all the stands in a group with per acre values that represent a weighted average for a particular forest type, standsize, and condition class.

For the procedure on making combine runs see the element VGMAINFO on the file PROGRAM and FSH 2409.26d, Chapter 90.

APPENDIX F - EXHIBIT 1

STANDARD INVENTORY TABLES REGION 2

AREA TABLES

A1 - AREA WITHIN NATIONAL FOREST BOUNDARIES BY LAND USE CLASS AND OWNERSHIP

A1A - AREA WITHIN NATIONAL FOREST BOUNDARIES BY COUNTY AND OWNERSHIP

A1B - AREA WITHIN DISTRICT BOUNDARIES BY COUNTY AND OWNERSHIP

A2 - AREA OF COMMERCIAL FORESTLAND BY FOREST TYPE, STANDSIZE CLASS, AND PRODUCTIVITY CLASS -- CUBIC FEET PER ACRE PER YEAR

A3 - AREA OF COMMERCIAL FORESTLAND BY AREA CONDITION CLASS AND FOREST TYPE

A4A - AREA OF COMMERCIAL FORESTLAND BY SITE TREE SPECIES AND SITE INDEX CLASS FOR THE SPRUCE-FIR FOREST TYPE

A4B-H - SAME AS A4A FOR THE OTHER 7 FOREST TYPES

A5 - AREA OF COMMERCIAL FORESTLAND SAWTIMBER STANDS BY FOREST TYPE, RISK CLASS, AND SCRIBNER VOLUME CLASS

A6 - AREA OF COMMERCIAL FORESTLAND BY FOREST TYPE AND BASAL AREA STOCKING CLASS

A7 - AREA OF CFL OF TREES 5-8.9 INCHES DBH IN SAWTIMBER STANDS AND 5 INCHES DBH PLUS IN POLETIMBER STANDS BY FOREST TYPE AND CUBIC VOLUME CLASS

A8 - AREA OF COMMERCIAL FORESTLAND BY FOREST TYPE, STANDSIZE CLASS, AND AGE CLASS

A9 - AREA OF COMMERCIAL FORESTLAND BY AGE CLASS AND PRODUCTIVITY CLASS

STEM TABLES

S1A - TOTAL LIVE STEMS 1 INCH DBH AND LARGER ON COMMERCIAL FORESTLAND OF THE SPRUCE-FIR FOREST TYPE BY SPECIES GROUP, STANDSIZE AND DBH CLASS

S1B-H - SAME AS TABLE S1A FOR THE OTHER 7 FOREST TYPES

S2 - TOTAL LIVE TREES 1 INCH DBH AND LARGER ON COMMERCIAL FORESTLAND FOR ALL FOREST TYPES BY SPECIES GROUP, STANDSIZE, AND DBH CLASS

S3A - TOTAL GS TREES 1 INCH DBH AND LARGER ON COMMERCIAL FORESTLAND OF THE SPRUCE-FIR FOREST TYPE BY SPECIES GROUP, STANDSIZE AND DBH CLASS

S3B-H - SAME AS S3A FOR THE OTHER 7 FOREST TYPES

S4 - TOTAL GS TREES 2 INCH DBH AND LARGER ON COMMERCIAL FORESTLAND BY SPECIES GROUP, STANDSIZE AND DBH CLASS

S5 - TOTAL LIVE TREES 1 INCH DBH AND LARGER ON COMMERCIAL FORESTLAND BY FOREST TYPE, DIAMETER RANGE CLASS AND DAMAGE CLASS

EXHIBIT 1--continued.

S6A - TOTAL ANNUAL MORTALITY CAUSED BY INSECTS (NUMBER OF STEMS 5 INCHES PLUS) BY SPECIES GROUP, STANDSIZE CLASS, AND DBH CLASS

S6B-H - SAME AS TABLE S6A FOR DISEASE, FIRE, ANIMALS, WEATHER, SUPPRESSION, LOGGING DAMAGE, AND OTHER REASONS

S7 - TOTAL ANNUAL MORTALITY TREES 5 INCHES DBH AND LARGER ON COMMERCIAL FORESTLAND BY SPECIES GROUP, STANDSIZE CLASS, AND DBH CLASS

CUBIC VOLUME TABLES

CVL - NET CUBIC VOLUME OF SOFTWOODS AND HARDWOODS ON COMMERCIAL FORESTLAND BY TIMBER CLASS

CV2A - NET CUBIC VOLUME OF GS TREES 5 INCHES DBH PLUS ON COMMERCIAL FORESTLAND OF THE SPRUCE-FIR FOREST TYPE BY SPECIES GROUP, STANDSIZE CLASS AND DBH CLASS

CV2B-H - SAME AS TABLE CV2A FOR THE OTHER 7 FOREST TYPES

CV3 - NET CUBIC VOLUME OF GS TREES 5 INCHES DBH PLUS ON COMMERCIAL FORESTLAND BY SPECIES GROUP, STANDSIZE CLASS, AND DBH CLASS

CV4 - NET CUBIC VOLUME OF SALVABLE DEAD (SOUND DEAD AND MORTALITY) ON COMMERCIAL FORESTLAND BY SPECIES GROUP, STANDSIZE AND DBH CLASS

CV5 - NET CUBIC VOLUME OF GS TREES 5-8.9 INCHES DBH IN SAWTIMBER STANDS AND OF GS TREES 5 INCHES DBH PLUS IN POLETIMBER STANDS ON COMMERCIAL FORESTLAND BY FOREST TYPE AND CUBIC VOLUME CLASS

CV6 - NET CUBIC PRODUCTS OF GS TREES 5-8.9 INCHES DBH AND UPPER STEM OF GS TREES 9 INCHES DBH PLUS ON CFL BY SPECIES GROUP, STANDSIZE, AND DBH CLASS

CV7 - NET CUBIC SAWLOG VOLUME OF GS TREES 9 INCHES DBH PLUS ON COMMERCIAL FORESTLAND BY SPECIES GROUP, STANDSIZE AND DBH CLASS

SCRIBNER VOLUME TABLES

SV1A - NET SCRIBNER VOLUME OF GS TREES 9 INCHES DBH PLUS ON CFL OF THE SPRUCE-FIR FOREST TYPE BY SPECIES GROUP, STANDSIZE, AND DBH CLASS

SV1A-H - SAME AS TABLE SV1A FOR THE 7 OTHER FOREST TYPES

SV2 - NET SCRIBNER VOLUME OF GS TREES 9 INCHES DBH PLUS ON COMMERCIAL FORESTLAND BY SPECIES GROUP, STANDSIZE AND DBH CLASS

SV2A - NET SCRIBNER VOLUME OF GS TREES 7 INCHES DBH PLUS ON PRODUCTIVE FORESTLAND BY SPECIES GROUP, STANDSIZE AND DBH CLASS

SV3 - NET SCRIBNER VOLUME OF GS TREES 9 INCHES DBH PLUS ON COMMERCIAL FORESTLAND BY FOREST TYPE, RISK CLASS AND AGE CLASS FOR SAWTIMBER STANDS ONLY -

SV4 - NET SCRIBNER VOLUME OF GS TREES 9 INCHES PLUS ON COMMERCIAL FORESTLAND BY FOREST TYPE AND AVERAGE PER ACRE SCRIBNER VOLUME CLASS FOR SAWTIMBER STANDS ONLY

INTERNATIONAL VOLUME TABLES

IV1A - NET INTERNATIONAL VOL OF GS TREES 9 INCHES DBH PLUS (SOFTWOODS) AND 9 INCHES DBH PLUS (HARDWOODS) ON COMMERCIAL FORESTLAND OF THE SPRUCE-FIR FOREST TYPE BY SPECIES GROUP, STANDSIZE, AND DBH CLASS

IV1B-H - SAME AS TABLE IV1A FOR THE 7 OTHER FOREST TYPES

IV2 - NET INTERNATIONAL VOLUME OF GS TREES 9 INCHES DBH PLUS (SOFTWOODS) AND 9 INCHES DBH PLUS (HARDWOODS) ON COMMERCIAL FORESTLAND BY SPECIES GROUP, STANDSIZE, AND DBH CLASS

GROWTH TABLES

G1 - NET ANNUAL CUBIC GROWTH OF GROWING STOCK TREES 5 INCHES DBH AND LARGER ON COMMERCIAL TIMBERLAND OF THE DOUGLAS FIR-WHITE FIR FOREST TYPE BY STANDSIZE CLASS, SPECIES GROUP, AND DBH CLASS

G2 -

G8 - SAME AS TABLE G1 FOR THE OTHER 7 FOREST TYPES

G9 - NET ANNUAL CUBIC GROWTH OF GROWING STOCK TREES 5 INCHES DBH AND LARGER ON COMMERCIAL TIMBERLAND BY STANDSIZE CLASS, SPECIES GROUP, AND DBH CLASS

G10 - SAME AS TABLE G1-G9 EXCEPT FOR SCRIBNER GROWTH WITH A 9 INCH DBH BREAK

G18 -

G19 - SAME AS TABLE G1-G9 EXCEPT FOR INTERNATIONAL GROWTH WITH A 9 INCH DBH

G27 - BREAK FOR SOFTWOODS AND AN 11 INCH DBH BREAK FOR HARDWOODS

MORTALITY TABLES

M1 -

M27 - SAME AS TABLES G1-G27 EXCEPT FOR MORTALITY

PER ACRE TABLES

COMBINED STAND RUNS WILL BE MADE USING THE VARGEN PROGRAM WITH SAMPLING OPTIONS CORRESPONDING TO FINSYS FOR ALL 32 TYPE AND STANDSIZE COMBINATIONS ON COMMERCIAL TIMBERLAND. ONE RUN WILL ALSO BE MADE COMBINING ALL COMMERCIAL SAMPLES ON THE FOREST. ADDITIONAL RUNS WILL BE MADE AT THE FORESTS REQUEST FOR MANAGEMENT PLANNING NEEDS.

EXHIBIT 2

STANDARD INVENTORY TABLE LABELS R2

AREA CONDITION CLASSES
- 10 - AT LEAST 100% DESIRABLE TREE STOCKING, NOT OVERSTOCKED
- 20 - AT LEAST 100% DESIRABLE TREE STOCKING, OVERSTOCKED
- 30 - 60 TO 100% DESIRABLE TREE STOCKING, LESS THAN 30% OF THE AREA CONTROLLED BY ACCEPTABLE, CULL TREES, INHIBITING VEGETATION, SLASH, OR NONSTOCKABLE CONDITIONS
- 40 - 60 to 100% DESIRABLE TREE STOCKING, 30% OR MORE OF THE AREA CONTROLLED BY OTHER TREES OR OVERSTOCKED AREAS AND OR CONDITIONS THAT ORDINARILY PREVENT OCCUPANCY BY DESIRABLE TREES
- 50 - LESS THAN 60% DESIRABLE STOCKING, AT LEAST 100% GROWING STOCK TREE STOCKING
- 60 - LESS THAN 60% DESIRABLE TREE STOCKING, 60 to 100% GROWING STOCK TREE STOCKING
- 70 - LESS THAN 60% DESIRABLE TREE STOCKING, LESS THAN 60% GROWING STOCK TREE STOCKING

AGE CLASSES
- NONSTOCKED
- 1-20 YEARS
- 21-40
- 41-60
- 61-80
- 81-100
- 101-120
- 121-140
- 141-160
- 161-180
- 181-200
- 201-300
- 300 PLUS

BASAL AREA STOCKING CLASSES
- 0-19 SQUARE FEET OF BASAL AREA PER ACRE FOR LIVE TREES 5 INCHES DBH PLUS
- 20-39
- 40-59
- 60-79
- 80-99
- 100-119
- 120-139
- 140-159
- 160-179
- 180 PLUS

CUBIC VOLUME CLASSES
- 0 NET CUBIC VOLUME PER ACRE OF LIVE GROWING STOCK TREES
- 1-499
- 500-999
- 1000-1499
- 1500-1999
- 2000-2999
- 3000 PLUS

EXHIBIT 2--continued

DBH CLASSES
1.0-2.9 INCHES DIAMETER BREAST HEIGHT
3.0-4.9
.
.
.
27.0-28.9
29.0-99.9

DIAMETER RANGE CLASSES
1.0-4.9 INCHES DIAMETER BREAST HIGH
5.0-8.9
9.0 PLUS

DAMAGE CLASSES
NO SERIOUS DAMAGE
BARK BEETLES
DEFOLIATORS
IPS BEETLE IN PONDEROSA PINE
STEM AND TOP RUSTS
BUTT ROT
NEEDLE BLIGHTS
DWARF MISTLETOE
STEM ROT
WESTERN GALL RUST
BROOM RUSTS
ROOT ROT
FOLIAGE DISEASE
FIRE
DOMESTIC ANIMALS
PORCUPINE -1/2 OR MORE OF STEM CIRCUMFERENCE GIRDLED
OTHER WILDLIFE
BIG GAME (DEER, ELK, MOOSE, BEAR, ETC.)
HARES, RABBITS
SMALL RODENTS
WIND
LIGHTENING
SNOW DAMAGE
FROST CRACK
MECHANICAL DAMAGE FROM WINDTHROWS, BOULDERS, VEHICLES
SUNSCALD
SUPPRESSION
LEANING 15 DEGREES OR MORE FROM VERTICLE
FORKED OR MULTIPLE STEM WITHIN MERCHANTABLE HEIGHT; FORKED SEEDS & SAPS
BROKEN TOP
DEAD TOP
EXCESSIVELY LIMBY TREE
UNHEALTHY FOLIAGE
WILL NOT PRODUCE A 12' SOFTWOOD LOG, or 8' HARDWOOD LOG (SOUND CULL)
FORKED OR MULTIPLE STEM ABOVE MERCHANTABLE HEIGHT
10% OR MORE DEFECT FROM SWEEP OR CROOK
LOGGING DAMAGE
TSI DAMAGE
LAND CLEARING DAMAGE
LESS THAN 8' USABLE BOLT IN BUTT SECTION OF POLETIMBER TREE (SOUND CULL)

EXHIBIT 2--continued

FOREST TYPES
- SPRUCE-FIR, WHITE SPRUCE (SD, NE)
- PONDEROSA
- DOUGLAS FIR-WHITE FIR
- PINES, OTHER* - LIMBER, WHITEOAK, BRISTLECONE
- PINYON-JUNIPER, EASTERN RED CEDAR (NE)
- LODGEPOLE, JACK PINE (NE)
- ASPEN
- HARDWOOD,* - OAK, COTTONWOOD

LAND USE CLASSES
- PRODUCTIVE FOREST NONRESERVED, NONDEFERRED (COMMERCIAL TIMBERLAND)
- PRODUCTIVE FOREST DEFERRED
- PRODUCTIVE FOREST RESERVED
- NONPRODUCTIVE FOREST NONRESERVED, NONDEFERRED
- NONPRODUCTIVE FOREST DEFERRED
- NONPRODUCTIVE FOREST RESERVED
- NONFOREST NONRESERVED, NONDEFERRED
- NONFOREST DEFERRED
- NONFOREST RESERVED
- CENSUS WATER NONRESERVED, NONDEFERRED
- CENSUS WATER DEFERRED
- CENSUS WATER RESERVED
- NONCENSUS WATER NONRESERVED, NONDEFERRED
- NONCENSUS WATER DEFERRED
- NONCENSUS WATER RESERVED

OWNERSHIP
- NATIONAL FOREST
- NATIONAL PARK SERVICE
- BLM
- INDIAN
- MISCELLANEOUS FEDERAL
- STATE
- COUNTY AND MUNICIPAL
- FARMER
- OTHER FOREST INDUSTRY
- MISCELLANEOUS PRIVATE

PRODUCTIVITY CLASSES
- 20-49 CUBIC FEET PER ACRE PER YEAR BASED ON NATURAL STANDS AT CULMINATION OF MEAN ANNUAL INCREMENT
- 50-84
- 85-119
- 120-164
- 165 PLUS

RISK CLASSES
- 1 - LESS THAN 10% STOCKING IN HIGH AND LOW RISK TREES
- 2 - LESS THAN 25% STOCKED WITH LOW RISK TREES, 75% PLUS STOCKED WITH HIGH RISK TREES
- 3 - 25-49% STOCKED WITH LOW RISK TREES
- 4 - 50-74% STOCKED WITH LOW RISK TREES
- 5 - 75% OR MORE STOCKING IN LOW RISK TREES

* ONLY AREA TABLES FOR SUBGROUPS WILL BE COMPILED

EXHIBIT 2--continued

RATIO CLASSES
- CUBIC VOLUME SAWLOG/CUBIC VOLUME TO A 4 INCH TOP DIB
- SCRIBNER VOLUME/CUBIC VOLUME TO A 4 INCH TOP DIB
- SCRIBNER VOLUME/CUBIC VOLUME SAWLOG
- INTERNATIONAL VOLUME/SCRIBNER VOLUME

SPECIES GROUPS:
- TRUE FIRS (15,18,19)
- SPRUCE (93,94,96)
- PONDEROSA PINE (122)
- JUNIPER AND OTHER PINES
- DOUGLAS FIR (202)
- ASPEN (746)
- OTHER HARDWOODS

SITE TREE SPECIES
- UNCLASSIFIED (50 YEAR BASE)
- SPRUCE-FIR (50 YEAR BASE)
- ALL PINES (50 YEAR BASE)
- DOUGLAS FIR-WHITE FIR (50 YEAR BASE)
- ASPEN AND OTHER HARDWOODS (50 YEAR BASE)

SITE INDEX CLASSES
- 0-9
- 10-19
- 20-29
- .
- .
- .
- 90-99
- 100 PLUS

SCRIBNER VOLUME CLASSES
- 0-1499 NET BOARD FT. SCRIBNER VOLUME PER ACRE OF LIVE GROWING STOCK TREE
- 1500-2999
- 3000-4999
- 5000-9999
- 10000 PLUS

TIMBER CLASSES
- SAWTIMBER SAWLOG 9.0-10.9 INCHES DBH
- SAWTIMBER SAWLOG 11 INCHES DBH PLUS
- SAWTIMBER UPPER STEM 9.0-10.9 INCHES DBH
- SAWTIMBER UPPER STEM 11 INCHES DBH PLUS
- POLETIMBER TREES 5-8.9 INCHES DBH
- SOUND CULL TREES 5 INCHES DBH PLUS
- ROTTEN CULL TREES 5 INCHES DBH PLUS
- SOUND MORTALITY TREES 5 INCHES DBH PLUS
- SOUND DEAD TREES 5 INCHES DBH PLUS

STANDSIZE
- SAWTIMBER
- POLETIMBER
- SEED-SAP
- NON-STOCKED

EXHIBIT 3

AREA CONTROL WORKSHEET

STATE_____ FOREST_____ WC____

	PI POINTS	AREA
GROSS AREA		
OTHER OWNERSHIP		
NATIONAL FOREST OWNERSHIP		
NATIONAL FOREST OWNERSHIP RESERVED		
PRODUCTIVE		
UNPRODUCTIVE		
NON-FOREST		
WATER		
NATIONAL FOREST OWNERSHIP NON-RESERVED		
PRODUCTIVE AND UNPRODUCTIVE		
NON-FOREST		
WATER		
NATIONAL FOREST OWNERSHIP DEFERRED		
PRODUCTIVE AND UNPRODUCTIVE		
NON-FOREST		
WATER		
NATIONAL FOREST OWNERSHIP NON-RESERVED, NOT DEFERRED		
PRODUCTIVE AND UNPRODUCTIVE		
NON-FOREST		
WATER		

EXPANSION FACTOR TO BE USED FOR CFL, NOT RESERVED TABLE_____

TOTAL PI-AREA TO BE USED FOR CFL, NOT RESERVED TABLE_____

STRATUM WEIGHTS TO BE USED IN ORDER OF TAPE POSITION_____

STRATA	WEIGHT

* = AREA ESTIMATE FROM PHOTO STRATUM AREAS

EXHIBIT 4

CONSISTENCY CHECKS

1. Consistency Check #1, for hand computation of area by land class within each sampling stratum. The column totals are the land class totals output in the final printed tables. The individual values are computed by multiplying the ratio of field locations in the land class within a sampling stratum, by the stratum weight, (
) and multiplying this result by the sample area divided by the stratum weights summed over all strata. Summing this expression over all the sampling strata results in the land class estimate for the total sample area.

2. Consistency Check #2, to check the consistency of totals between tables totaling to the same value. This check will be needed for the total pass (all tables) only.

3. Consistency Check #3, to determine per acre and percent of inventory values for volume, net growth, mortality, and gross growth by unit of measure and sawtimber and poletimber tree size classes. This check will be made for the total pass.

4. Consistency Check #4, to compute the average volume per tree by species and diameter class for the selected unit of measure. The check is needed for the total pass, cubic, international ¼, and Scribner volume.

5. Consistency Check #5, to compute average volume per acre by forest type (usually local type) and stand size class. This check is needed for the total pass for cubic, international ¼, and Scribner volume.

EXHIBIT 4--continued

FOREST SURVEY
July 1971

CONSISTENCY CHECK NO. 2

IFARES, Ogden, Utah
Date _____

S. Section X / _____
S. Region X / _____
State XX / _____
Inventory Date: _____
Prepared by: _____

Survey Unit X / _____
Region-Forest XXX / _____
Working Circle X / _____
County XXX / _____
Special Area: _____

Table Totals

Table Total		Table Numbers
_____	Commercial Forest Land	_____
_____	Noncommercial Forest Land	_____
_____	Cu. Ft. Growing Stock Volume	_____
_____	Cu. Ft. Poletimber GS Volume	_____
_____	Cu. Ft. Sawtimber GS Volume-Sawlog	_____
_____	Cu. Ft. Sawtimber GS Volume-Upper	_____
_____	Bd. Ft. Int. 1/4 Sawtimber GS Volume	_____
_____	Bd. Ft. Scribner Sawtimber GS Volume	_____
_____	Number of GS Trees	_____
_____	Cu. Ft. GS Net Growth	_____
_____	Bd. Ft. Int. 1/4 GS Net Growth	_____
_____	Bd. Ft. Scribner GS Net Growth	_____
_____	Cu. Ft. GS Mortality	_____
_____	Bd. Ft. Int. 1/4 Mortality	_____
_____	Bd. Ft. Scribner Mortality	_____
_____	_____	_____
_____	_____	_____

EXHIBIT 4--continued

CONSISTENCY CHECK NO. 3

4810-59
FOREST SURVEY
July 1971

IFERES, Ogden, Utah
Date ____

S. Section X ____ /
S. Region X ____ /
State XX ____ /
Prepared by: ____

Survey Unit X ____ /
Region-Forest XXX ____ /
Working Circle X ____ /
County XXX ____ /
Special Area: ____

CFL ____ acres	Cubic Foot Volume			Board Foot Volume			
	Total (1)	Per acre (2)	% of Inv. (3)	Total (4)	Per acre (5)	% of Inv. (6)	Bd.ft./cu (7)
(1) Poletimber G.S. Volume							
(2) Sawtimber G.S. Volume							
(3) Total Sawtimber & Poletimber G.S. Volume							
(4) Poletimber Net Growth							
(5) Sawtimber Net Growth							
(6) Total Net Growth							
(7) Poletimber Mortality							
(8) Sawtimber Mortality							
(9) Total Mortality							
(10) Poletimber Gross Growth							
(11) Sawtimber Gross Growth							
(12) Total Gross Growth							

EXHIBIT 4--continued

Forest Survey
July 1971

CONSISTENCY CHECK NO. 4

Date

S. Section X /

S. Region X /

State XX /

Inventory Date:

Prepared by:

Survey Unit X /

Region-Forest XXX /

Working Circle X /

County XXX /

Special Area:

Volume Ratios

Bd of Volume: Volume/ Volume

Diameter: Species or Species Group

Class								Tot
10								
12								
14								
16								
18								
20								
22								
24								
26								
28								
30								
32								
34								
36								
38								
40								
42								
44								
46								
48								
50+								
Total								

EXHIBIT 4--continued

FOREST SURVEY
July 1971

CONSISTENCY CHECK NO. 5

Date _____

S. Section X ___/___

S. Region X ___/___

State XX ___/___

Inventory Date: _____

Prepared by: _____

Survey Unit X ___/___

Region-Forest XXX ___/___

Working Circle X ___/___

County XXX ___/___

Special Area: _____

Average Volume Per Tree

Volume Units: _____

Diameter: _____ Species or Species Group

Class	:	:	:	:	:	:	:	:	:	To
6										
8										
10										
12										
14										
16										
18										
20										
22										
24										
26										
28										
30										
32										
34										
36										
38										
40										
42										
44										
46										
48										
50+										
Total										